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DRINKING WATER SOURCE PROTECTION PLAN

Arches National Park
Headquarters Well No. 3

August 2001

WATER RESOURCES DIVISION

National Park Service - Department of the Interior
Fort Collins - Denver - Washington

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DRINKING WATER SOURCE PROTECTION PLAN

Arches National Park
Headquarters Well No. 3

August 2001

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WATER RESOURCES DIVISION

National Park Service - Department of the Interior
Fort Collins - Denver - Washington

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EXECUTIVE SUMMARY

Well No. 3 at the Headquarters Area, Arches National Park supplies water for a transient, non-community water system. The well provides water for visitor uses at the main park entrance, the maintenance area, and employee housing and offices. Water from this well is trucked to the Island in the Sky area in Canyonlands National Park for potable water use there. The water system is operated year round.

Well No. 3 is 172 feet deep and is completed in the Navajo Sandstone. Water is obtained from fractures in the sandstone.

The optional two-mile radius was used as the area for conducting an inventory of potential contaminant sources for developing this drinking water source protection plan. There are few potential contaminants in the area. Most potential contaminant sources in the area are under the direct control of the National Park Service.

The following procedures are recommended to reduce the potential for contamination of the ground-water resource and drinking water supply at the Headquarters Area of Arches National Park. These procedures and practices have already been implemented by park staff.

1. Make certain that Well No. 2, the old well, is adequately capped to prevent contaminants from entering the aquifer.
2. Continue periodic inspection of areas where paint, solvents, etc. are stored in the maintenance area.
3. Purchase paint, solvents, etc. on an as-needed basis to reduce quantities stored on site.
4. Provide secondary containment for all potential contaminants.

1.0 INTRODUCTION

Arches National Monument was created in 1929. In 1971, the park was enlarged and designated Arches National Park. In 1998, the Lost Spring Canyon area (3140 acres) was added to the park. Arches National Park was set aside to preserve and protect more than 2000 natural sandstone arches and a variety of other unique geological features. Arches National Park includes 76,519 acres. Annual visitation is approximately 870,000 persons.

The Headquarters Area of Arches National Park is about 4 miles north of Moab, Utah. The Headquarters Area is the main park entrance and includes a visitor center, maintenance yard, employee housing, and offices. The general location is shown on the map in Figure 1.

1.1 System Information

National Park Service
Arches National Park
Utah DEQ Number 10021

This is a transient, non-community public water supply system. The well was constructed in 1978 to a depth of 172 feet. Water is obtained from the Navajo Sandstone Formation.

1.2 Source Information

The well at the Headquarters Area was constructed in 1978. This is the third well that has been used to supply water in the area. Well No. 1 was constructed in 1940 to a depth of 117 feet. Well No. 2 was constructed in 1958 to a depth of 123 feet. Both of these wells were located about 2000 feet northwest of the present well, Well No. 3.

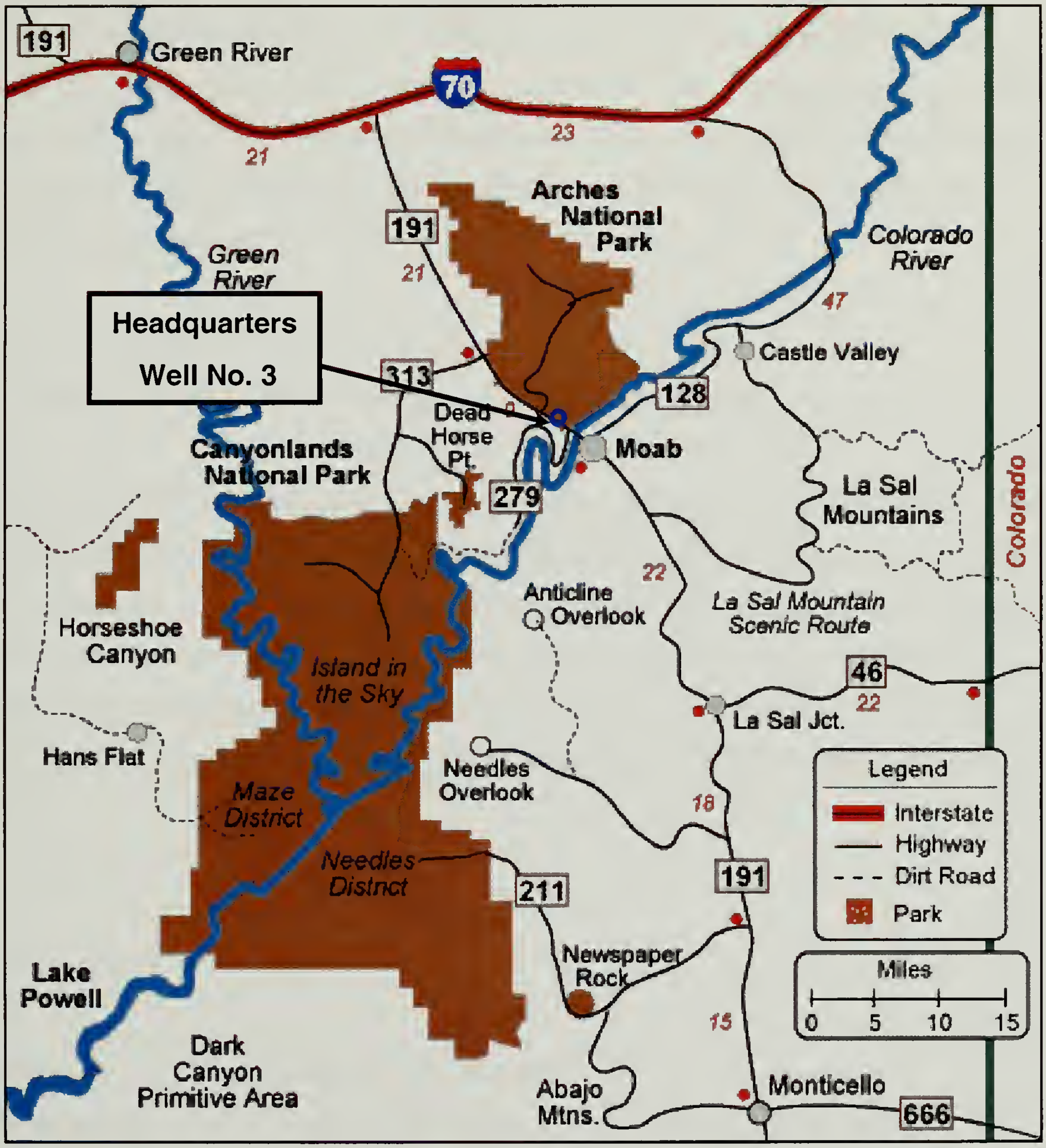


Figure 1. General Location Map

Well No. 3 is 172 feet deep with 8-inch casing. The casing is perforated from 112-172 feet. Static water level in the well is about 114 feet below ground surface. The well was test pumped at 30 gpm for 24 hours, resulting in 2 feet of drawdown. The specific capacity of the well was 15 gpm/ft of drawdown. A copy of the well log and drawdown and yield test data are included in the appendices of this report. The well, with its current pump, produces 11-12 gpm.

The legal description of the well location is;

NW¼ of NW¼ of SW¼, Section 21, T25S, R21E SLBM

Water is used primarily for drinking and restroom facilities by park visitors and staff at the visitor center, maintenance area, park offices, and the housing area. Some water is used for irrigation of landscaped areas. Approximately 250,000 gallons per year are trucked to the Island in the Sky area of Canyonlands National Park. Water use generally ranges from about 100,000 gallons per month in the off-season to about 450,000 gallons per month in the summer. Average monthly water use is shown in Figure 2.

1.3 Designated Person - R309-113-5:

Owner:	National Park Service	
Superintendent:	J. Rockford Smith	Phone: (435)-719-2100
Facility Manager:	Rodney Robey	Phone: (435)-719-2250
Address:	2822 South West Resource Blvd. Moab, UT 84532	

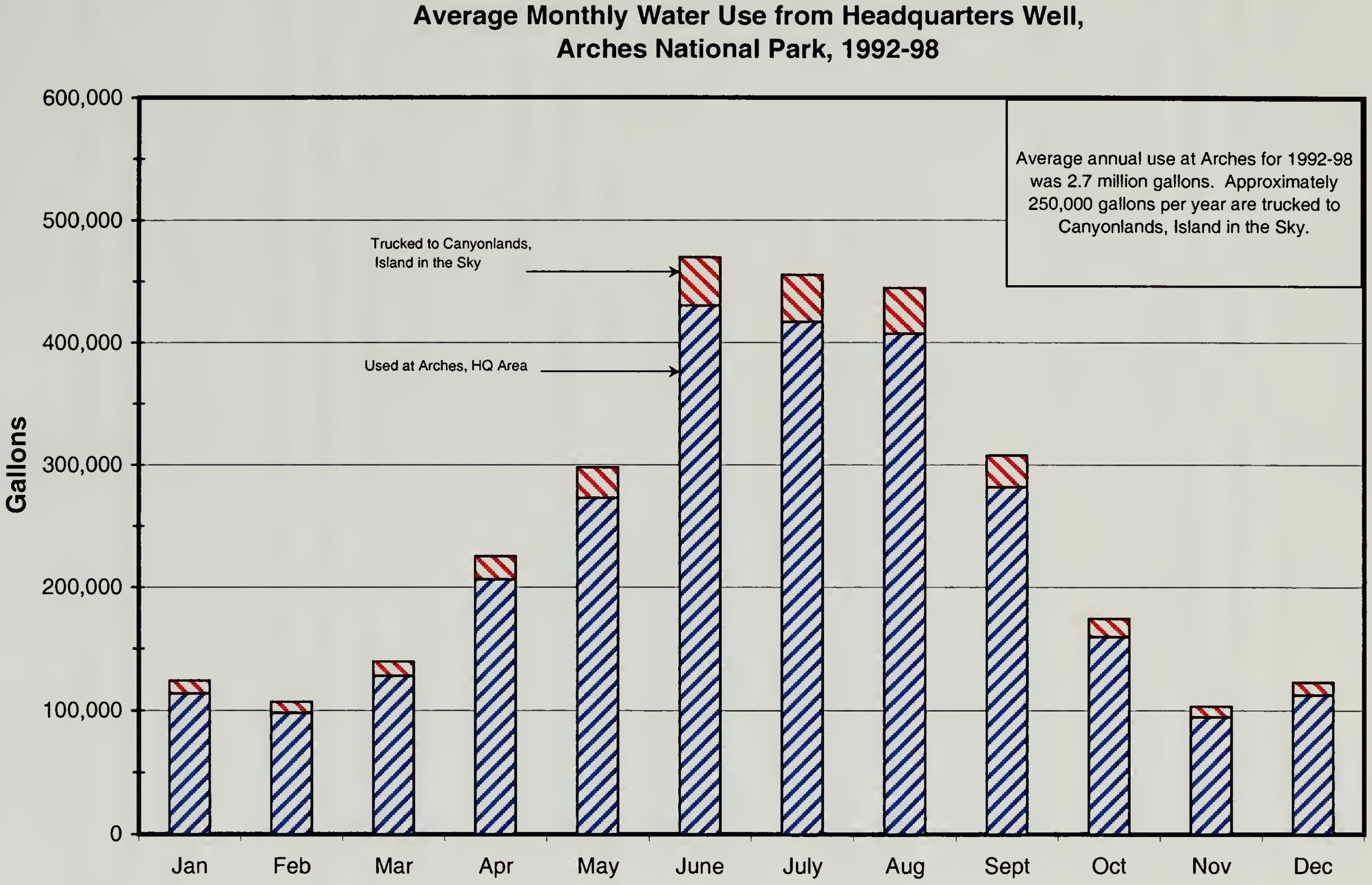


Figure 2. Average monthly water use.

2.0 THE DELINEATION REPORT - R309-113-9(5)

The primary sources of hydrogeologic information for this report are unpublished reports, memos, and other documents in the files of the National Park Service Water Resources Division in Ft. Collins, Colorado. The geology of the area is described by Doelling (1985 and 2000). Price (1959) describes the drilling and testing of Well No. 2, which was constructed in 1958. Well No.2 is similar to Well No. 3, which is currently used. Water quality data were provided by the Utah Division of Drinking Water.

2.1 Geologic Data - R309-113-9 (5)(a)(i)

Hydrogeology

The well is completed in the Navajo Sandstone, a fine-grained, well-cemented sandstone that was originally deposited as sand dunes. Most of the water production occurs from fracture zones in the sandstone.

The Moab Fault trends NW-SE in this area forming the valley of Moab Wash. Numerous small faults are mapped in the Headquarters Area (Doelling, 1985) approximately parallel to the Moab Fault. These faults, and associated secondary fractures, probably act as a collection system for groundwater in the Navajo Sandstone, resulting in the large production from Well No. 3.

Older rocks have been uplifted southwest of the Moab Fault. These formations probably form a relatively impermeable barrier to ground water flow from the northeast in the Navajo Aquifer. The older formations southwest of the Moab Fault probably do not contribute groundwater to Well No. 3 in the Headquarters Area.

Most of the recharge and groundwater flow contributing water to Well No.3 probably occurs in the area of the park northeast of the Headquarters Area, between Moab Wash and Salt Valley. Navajo Sandstone and younger formations outcrop in most of

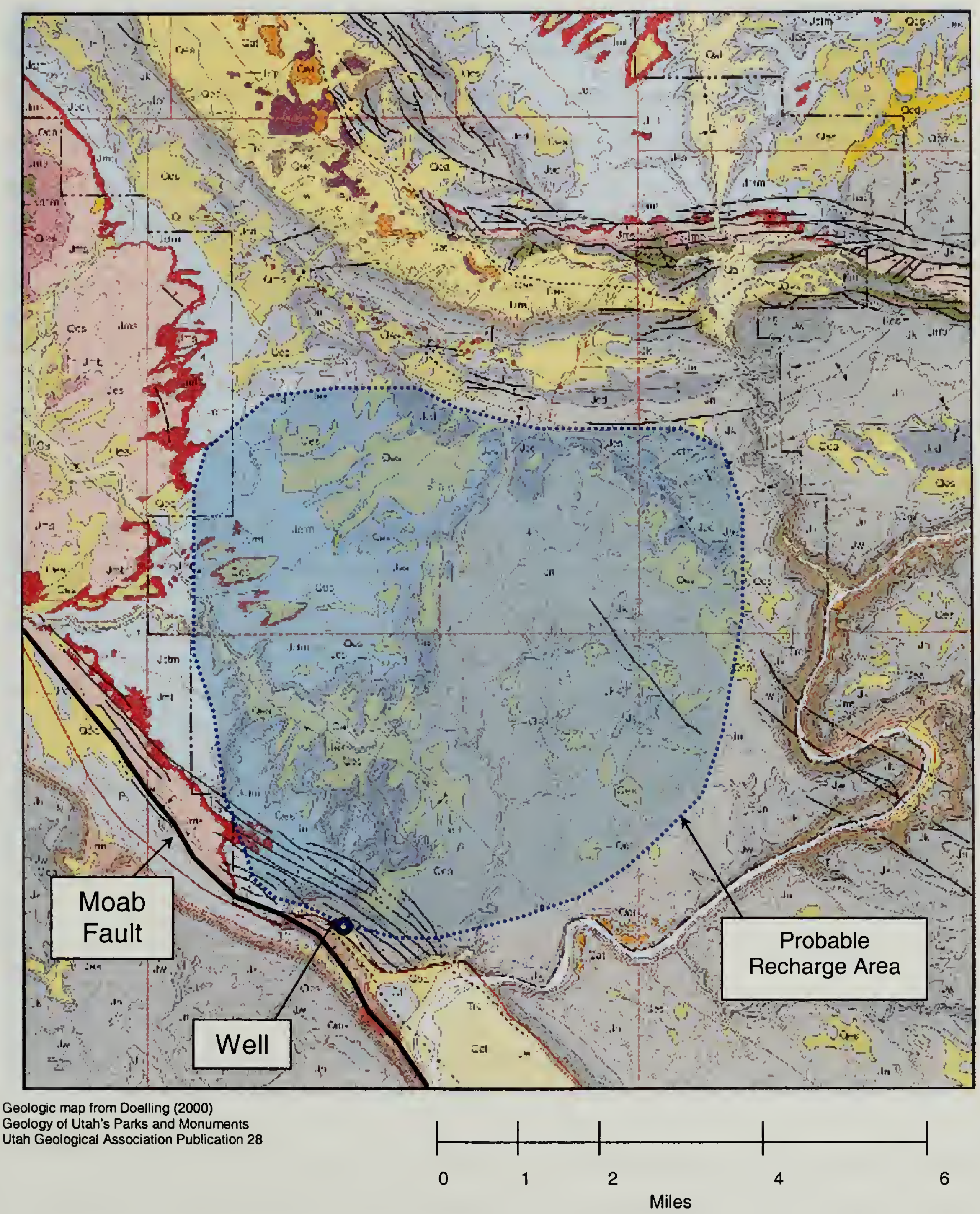
the area between Salt Valley and Moab Wash. Infiltration of precipitation in this area is likely the source of groundwater pumped from Well No. 3. The area of probable groundwater recharge is shown on Figure 3.

Water Quality

Water quality data for the Headquarters Area Well No. 3 are summarized in Table 1. Water is chlorinated and stored in a 50,000-gallon storage tank located part way up the hill southeast of the Maintenance Area. The water is hard, approximately 350 ppm as $CaCO_3$. The excessive hardness contributes to mineral buildup and maintenance problems at both the Arches Headquarters area and Canyonlands Island in the Sky. These problems include replacing hot water heaters and repairing/replacing faucets and valves. Total dissolved solids concentration is high, approximately 800-900 ppm, that is above the recommended limit of 500 ppm, but still below the Utah DEQ maximum contaminant level of 1000 ppm. Nitrate concentrations have increased from about 2-3 ppm prior to 1992 to about 6-7 ppm in the late 90's (6.73 ppm in Spring 2001). It is hypothesized that this increase in nitrate concentration may represent loading from septic leachfields upgradient from the park's water supply well.

Table 1. General water quality, Headquarters Area Well No.3

Date	4/17/81	4/12/84	5/22/85	5/16/88	6/17/91	1/18/96	2/28/96
PH	8.0	7.5	---	8.1	7.9	---	---
Turbidity, NTU	6.0	2.2	1.6	0.4	0.2	0.5	0.9
Spec. Cond. (umhos)	845	875	1330	1350	1360	1305	1276
Hardness ($CaCO_3$)	298	292	400	346	345	354	359
TDS (mg/l)	546	522	846	868	900	816	794
Ca (mg/l)	70	69	97	81	79	84	86
SO_4 (mg/l)	191	198	236	220	240	232	225
Cl (mg/l)	61	60	175	175	201	64	141
NO_3 (mg/l)	3.2	3.0	4.31	3.83	2.95	---	6.46



Geologic map from Doelling (2000)
Geology of Utah's Parks and Monuments
Utah Geological Association Publication 28

Figure 3. Geologic map of Southern Part of Arches National Park showing probable recharge area for Headquarters Well No. 3

Water quality data sheets are included in the appendices of this report. In 1991, water from Well No. 3 was tested for volatile organic compounds, pesticides, herbicides, and PCB's. None were found at concentrations exceeding the detection limits of the lab analyses.

A water sample collected on July 24, 1996 had an elevated gross alpha concentration of 24 pCi/l. Subsequent sampling and analyses indicate that this elevated concentration was an anomaly. Radionuclide data are shown in Table 2. The MCL for gross alpha is 15 pCi/l. The MCL for combined Radium-226 and Radium 228 is 5 pCi/l.

Table 2. Radionuclide water quality, Headquarters Area Well No.3

Date	7/24/96	11/07/96	12/18/96	1/7/97	2/13/97	4/3/97
Gross alpha, pCi/l	24±2.0	12.6±1.0	16±1.0	7±1.0	11.6±4.0	6.4±0.7
Gross Beta, pCi/l	13.9±4.0	13.7±4.7	14±4.0	13.3±4.9	14.2±4.0	12±4.0
Radium-226, pCi/l	<0.5±0.3	<0.5±0.8	<0.5±0.7	0.7±0.7	0.5±0.6	<0.5±0.5
Radium-228, pCi/l	1±3.6	1±2.2	2.5±2.7	<1±1.0	1.8±4.0	<1±4.0

2.2 Well Construction Data - R309-113-9 (5)(a)(ii) & (iii)

A copy of the well construction log is included in the Appendices of this report. The well was constructed in May 1978. It is 172 feet deep and was constructed entirely in the Navajo Formation. The well was completed with 8-inch casing through its entire depth. Casing in the lower 60 feet of the well was perforated with 16 cuts per foot, each perforation is 2" x ½". The well has a surface seal of 20 feet of concrete grout.

2.3 Aquifer Data - R309-113-9 (5)(a)(iv)

We have only very limited information regarding drawdown or recovery tests for this well. Water levels are not routinely monitored. The water level at the time of construction (1978) was 114 feet below ground surface. A drawdown and yield test was conducted on May 23-25, 1978. The well was pumped at 30 gpm for 24 hours, resulting in 2 feet of drawdown. No other wells were monitored during this test. The old well (Well No. 2) is the only other well in the area that is completed in the Navajo Sandstone. Conducting a new aquifer test, using Well No. 2 as an observation well, would not provide sufficient information to model groundwater flow rates or to determine the direction of groundwater flow.

2.4 Hydrogeologic Methods, Procedures, and Calculations - R309-113-9 (5)(a)(vii)

We have insufficient data to make predictions for groundwater travel times to the Headquarters Area Well No.3. Therefore, the optional two-mile radius delineation will be used to delineate the wellhead protection area.

2.5 Map Showing Boundaries of the DWSP Zones - R309-113-9 (5)(a)(viii)

Figure 4 is a map showing the area within two miles of the supply well.

2.6 Protected or Unprotected Aquifer Classification – R309-113-9(3) & (6)

The Headquarters Area Well No. 3 does not meet all of the criteria for classification as a protected aquifer, as described in the Utah DEQ guidelines for source water protection plans. The well does not have a grout seal that extends from ground surface to at least 100 feet below ground surface and for a minimum of 30 feet into an impermeable layer.

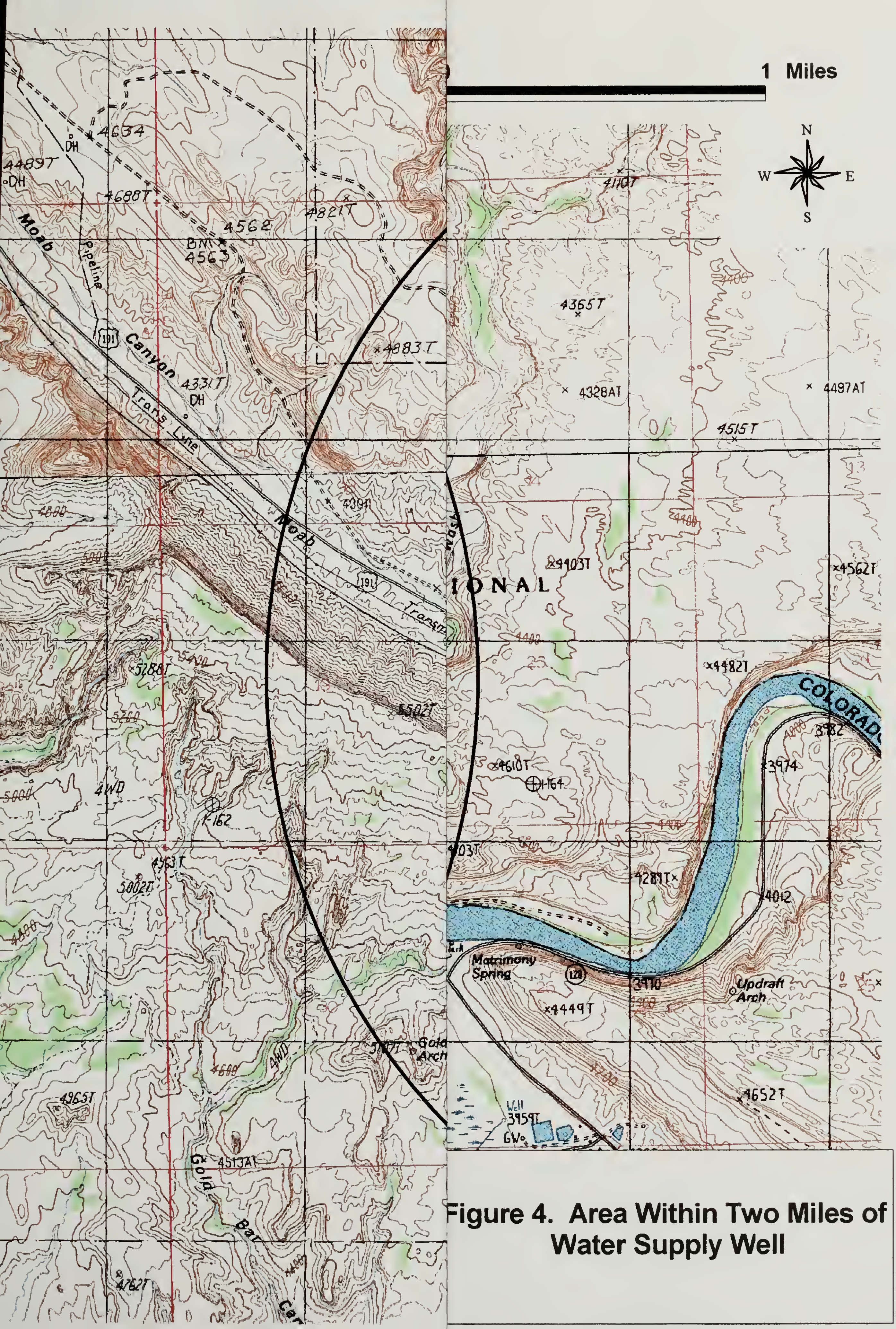


Figure 4. Area Within Two Miles of Water Supply Well

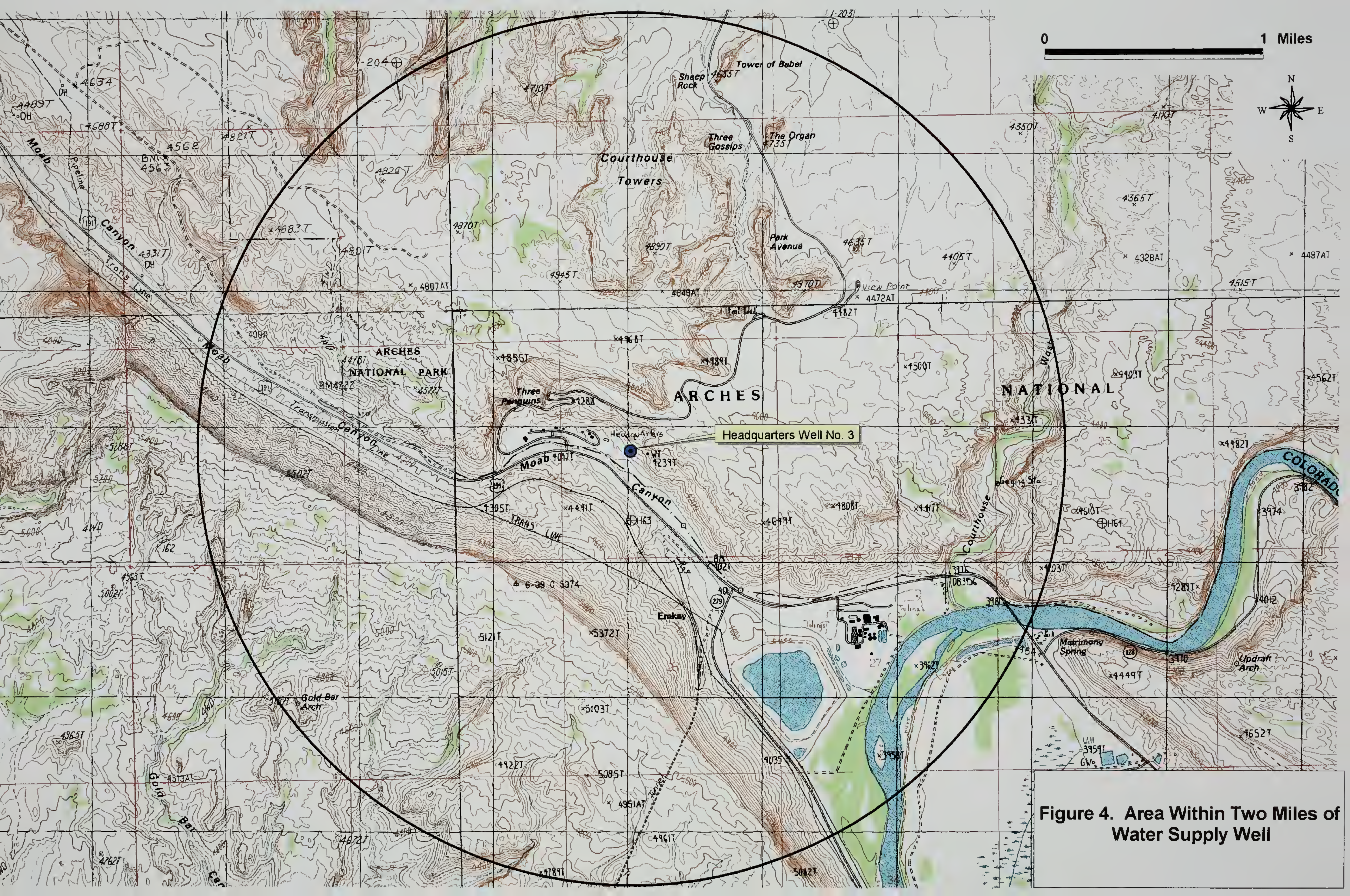


Figure 4. Area Within Two Miles of Water Supply Well

3.0 THE INVENTORY OF POTENTIAL CONTAMINATION SOURCES - R309-113-10

3.1 List Potential Contamination Sources - R309-113-10 (1)

Potential contaminant sources within two miles of the Headquarters Area Well No. 3 include: a heavily traveled state highway, a uranium mill tailings pile, septic tanks and leachfields, an abandoned water supply well, and small quantities of paint, oil, fuel, solvents, etc. in the maintenance area.

The abandoned Atlas uranium mill tailings pile is located about one mile southeast of the well. Planning is underway to possibly move the tailings to a more secure location in the desert.

State Highway 191 runs north-south between Moab and Interstate 70 about 30 miles to the north. Highway 191 is a major supply route for Moab and southern Utah.

There are three septic leachfields serving residences and offices in the employee housing and maintenance areas. A large leachfield is used to dispose of wastewater from the Visitor Center. All of these leachfields are upgradient from the well.

There was a 2000-gallon underground storage tank in the maintenance yard, but it was removed in Fall 2000. There are no bulk fuel storage tanks at the maintenance yard.

A new structure was completed in Spring/Summer 2001 for storage of herbicides, oil, gas, stain, paint, etc. The building has explosion proof wiring. It is constructed without a floor drain and with a six-inch sump to contain any spills.

At the maintenance building, chlorine bleach, cleaning supplies, and paint are stored on shelves in a building with a concrete floor and no floor drain.

The old well, Well No. 2, is located approximately 2000 feet northwest from Well No. 3. Well No. 2 is no longer used. It is capped, but has not been plugged.

3.2 Identify Hazards:

Potential contaminant sources, hazardous substances associated with each of the possible potential contaminant sources, and approximate quantities of each hazardous substance are listed in Table 3.

Table 3. Hazardous substances associated with each potential contaminant source

Potential Source	Hazardous Substances	Approximate Quantity
Uranium mill tailings	Radionuclides and chemicals	13 million tons of tailings
Maintenance shop	Chlorine bleach	Several 1-gallon containers
	Paint	Various quantities, generally 1-gallon or less, stored in a paint locker
	Lubricating oil, antifreeze, solvents	Several small (1-5 gallon) containers
Septic tanks and leachfields	Sewage	Sewage from the residential area, maintenance shop, park offices, and visitor center
Abandoned Well	Potential pathway for contaminants to enter the aquifer	
Spills on Hwy. 191	Anything that might be transported by truck	

3.3 Prioritize the Inventory - R309-113-10 (1)

None of the potential contaminants present a large risk to continued use of Well No. 3. Water wells in this area have supplied water for park facilities for 60 years with no known contamination events. Potential contaminants are either adequately controlled, occur in only small quantities, or are downgradient from the well.

The uranium mill tailings pile is hydrologically downgradient from Well No. 3. Contaminated water leaking from the bottom of the pile enters the alluvium and flows to the Colorado River.

Paint, thinner, solvents, fuel, oil, etc. are stored in small containers at the maintenance buildings. These materials are generally stored in small quantities, in areas where leaks could be readily observed, and secondary containment is provided. The park is actively working to reduce the inventory of these materials and also reduce the resultant waste stream.

Septic tanks and leachfields are located hydrologically upgradient within 1000-2000 feet of Well No. 3. Sewage disposal systems have been constructed, and are operated, in compliance with State and local regulations. Septic tanks are pumped on a regular basis.

Well No. 2 is a negligible risk to contamination of the aquifer. The well has been disconnected from the water system and capped to prevent accidental introduction of contaminants to the aquifer.

Spills or accidents on Hwy 191 are beyond the control of the National Park Service. This type of contaminant release would occur infrequently, have a limited release, and hopefully be captured and cleaned up fairly quickly. Accidents could have a significant

impact if not dealt with quickly. The highway and park entrance road parallels the main drainage of Moab Wash that runs past the water supply well.

3.4 Potential Contamination Source Location - R309-113-10 (1)

None of the potential contaminant sources are within the Zone 1 protection zone, 100-foot radius from the well.

The uranium mill tailings pile is approximately 1 mile southeast from Well No. 3. Chemicals, paint, cleaners, solvents etc. in the maintenance area are stored in a building about 1000 feet northwest from the well. The septic leachfields are 1000-2000 feet northwest, upgradient, from the well. The abandoned well is about 2000 feet northwest from Well No. 3.

3.5 Potential Contamination Sources Plotted on Map

Potential contamination sources are plotted on the map in Figure 5.

4.0 THE ASSESSMENT OF POTENTIAL CONTAMINATION SOURCE HAZARDS

Except for the uranium mill tailings and highway accidents, all potential contamination sources are under the direct control of the National Park Service. Potential contaminants at the Park are located primarily at the maintenance area. Solvents, degreasers, paint, lubricating oil, antifreeze, and similar materials (which might be classified as hazardous) are purchased and stored in small quantities, reducing the potential for release of large quantities of contaminants. The Park utilizes Best Management Practices to prevent or control release of potential contaminants.

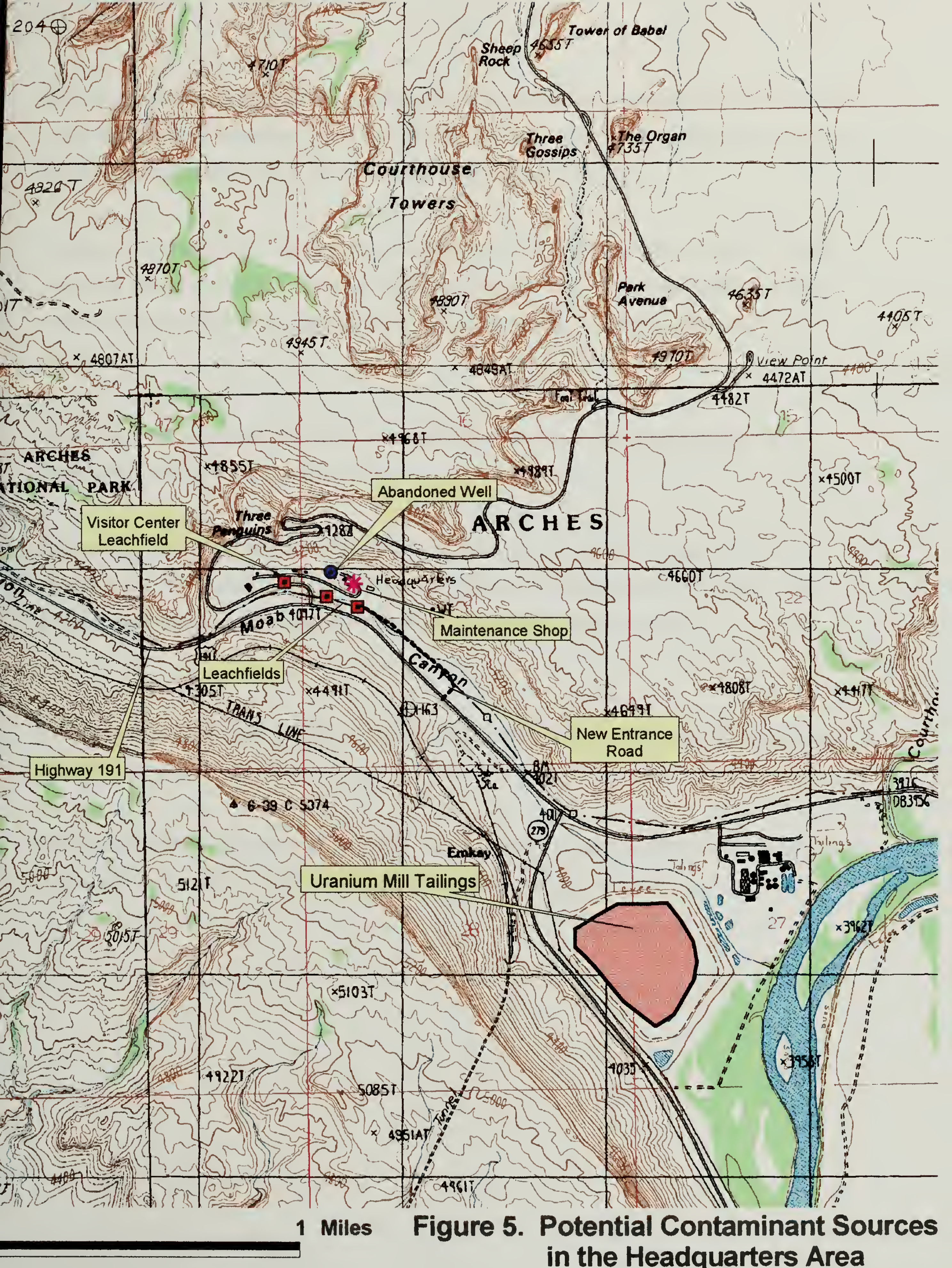


Figure 5. Potential Contaminant Sources in the Headquarters Area

Septic tanks and leachfields are constructed and operated in compliance with State and local regulations. However, since septic systems are designed to discharge, they must remain classified as uncontrolled potential contaminant sources.

Secondary containment vessels are provided for oil and fuel storage containers. Paint, solvents, cleaning fluids, and similar materials are stored on shelves in buildings with concrete floors. There are no floor drains in areas where potential contaminants are stored.

Paint, solvents, cleaning fluids, etc. are purchased on an as needed basis. Only negligible quantities are stored on site.

Potential contaminant sources listed in Table 3 are adequately controlled through a combination of regulatory, operational, physical, and negligible quantity controls. No further management strategies are necessary, unless conditions change.

5.0 THE MANAGEMENT PROGRAM FOR EXISTING POTENTIAL CONTAMINATION SOURCES - R309-113-11

Existing regulatory, operational, physical, and negligible quantity controls are adequate to prevent the accidental spill or release of potential contaminants.

6.0 THE MANAGEMENT PROGRAM FOR FUTURE POTENTIAL CONTAMINATION SOURCES - R309-113-12

6.1 Management Program - R309-113-13 (4)

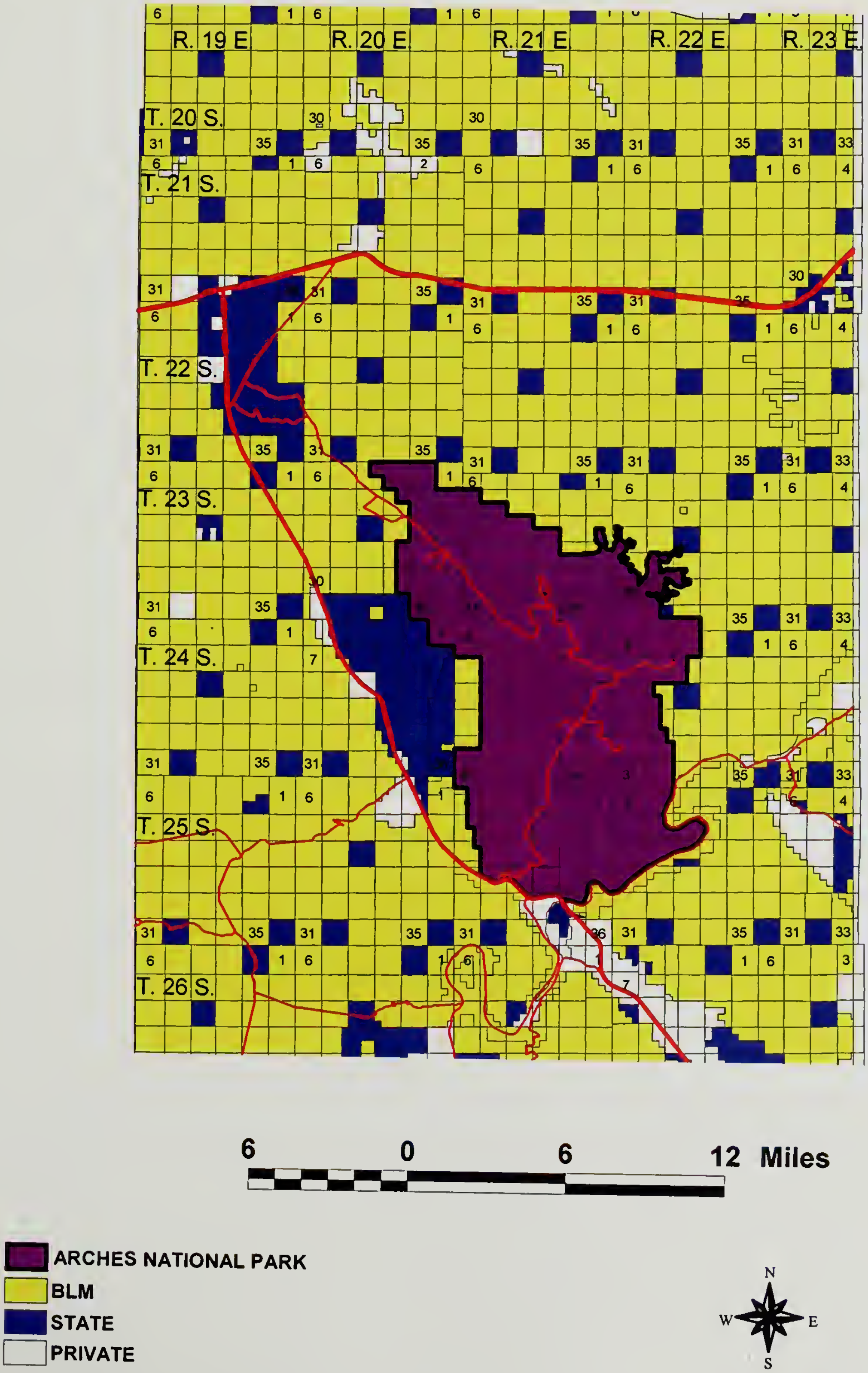
If there are any proposed changes to current land use and land management practices within two miles of the well, the National Park Service will review those proposed changes to determine whether the proposed change might have a deleterious impact on the water supply for the Park. No such changes are anticipated, except for the possible removal of the Atlas tailings pile located 1 mile southeast of the well. The entrance road into the park will be rerouted in 2002 and a new emergency services building is planned. These changes will not significantly affect the security of the park's water supply well.

All land for several miles to the north and east of the Headquarters Well No. 3 is owned and controlled by the National Park Service. Land to the west and southwest of the well is under the control of the U.S. Bureau of Land Management or the State of Utah. The only land available for private development is a narrow strip, about two miles wide, extending southeasterly starting about one mile southeast of the well. This strip comprises the Moab Valley. Only a small part of this private land lies north of the Colorado River. Land use activities south of the river will not affect water quality at the Headquarters well. The Colorado River is a regional groundwater discharge zone and acts as a hydrologic barrier to groundwater flow. Property ownership near Arches National Park is shown in Figure 6.

If any new potential contaminant sources are planned for the area in the future, the National Park Service will evaluate each source. This assessment will include;

- Determine whether it actually is a potential contaminant source.
- If it is, add it to the inventory.
- Identify and assess its controls.

Figure 6. Arches National Park Property Ownership



- Plan and implement land management strategies, if the potential contaminant is not adequately controlled.

7.0 THE IMPLEMENTATION SCHEDULE - R309-113-7 (1)(e)

No new land management strategies will be implemented under this plan. Current management practices are adequate to protect the groundwater resources at the Headquarters Well, which supplies all National Park Service facilities in the Headquarters Area.

Storage areas in the maintenance area are visually inspected daily to detect any leaks or spills from containers stored in these areas. Secondary containment is provided for all containers of oil, antifreeze, etc. Septic tanks are pumped twice a year, spring and fall.

8.0 THE RESOURCE EVALUATION - R309-113-7 (1)(f)

No additional financial resources are necessary to implement this source water protection plan.

9.0 THE RECORDKEEPING SECTION - R309-113-7 (1)(g)

All monitoring records, as-built construction drawings, water quality and water use data, etc., are kept in the office of the Facility Manager at the Maintenance Shop at Arches National Park.

This plan was developed by National Park Service staff. The plan will be reviewed and updated, as necessary, in 5 years, September 2006.

10.0 THE CONTINGENCY PLAN - R309-113-14

A specific contingency plan has not been developed for the Headquarters Area. A contingency plan would depend on the source and nature of the contamination, and the anticipated duration of the contaminant effects. Alternatives would include; constructing a new well in the general vicinity, constructing a treatment plant to remove the contaminants, and no longer providing potable water for park visitors. In the short-term, water for residents in park housing could be supplied with water trucked in from Moab.

11.0 ADDITIONAL INFORMATION AND POTENTIAL CHANGES

Several factors and potential land use changes have the potential to change conditions as described in this report. NPS staff will monitor these changes and make changes to this source water protection plan as necessary. These factors include;

1. A new entrance road has been designed to provide access to the park. Construction is planned for Summer 2002.
2. The Grand Valley Sewer and Water District has received a $1.7 million grant to extend utilities to Arches National Park. This is half of the amount needed for the project. The District is now trying to raise an additional $1.7 million to fully fund the project.
3. A new visitor center and new emergency services building are being planned/designed at this time.
4. The Department of Energy has $1.4 million to begin an engineering study to move the Atlas uranium mill tailings.

5. Current septic use estimates made by Frank Darcy several years ago (1998) indicate the Visitor Center was sending 15,000 gpd of sewage to the septic tanks and leachfields. In 1999, a new 12,000-gallon septic tank was constructed to service the Visitor Center. The old 6,000-gallon tank was left in line on the effluent side of the 12,000-gallon tank. No changes were made to the leachfield.

References

Doelling, Hellmut H., 1985, Geology of Arches National Park, Utah Geological and Mineral Survey Map 74, 15 pp., scale 1:50,000

Doelling, Hellmut H., 2000, Geology of Arches National Park, Grand County, Utah, in Geology of Utah's Parks and Monuments, Utah Geological Association Publication 28, D.A. Sprinkel, T.C. Chidsey, Jr., and P.B. Anderson, editors, pp. 11-36

Price, Don, 1959, Drilling and Test Pumping a Replacement Well at Arches National Monument, Grand County, Utah, USGS Open-File Report, 12 pp.

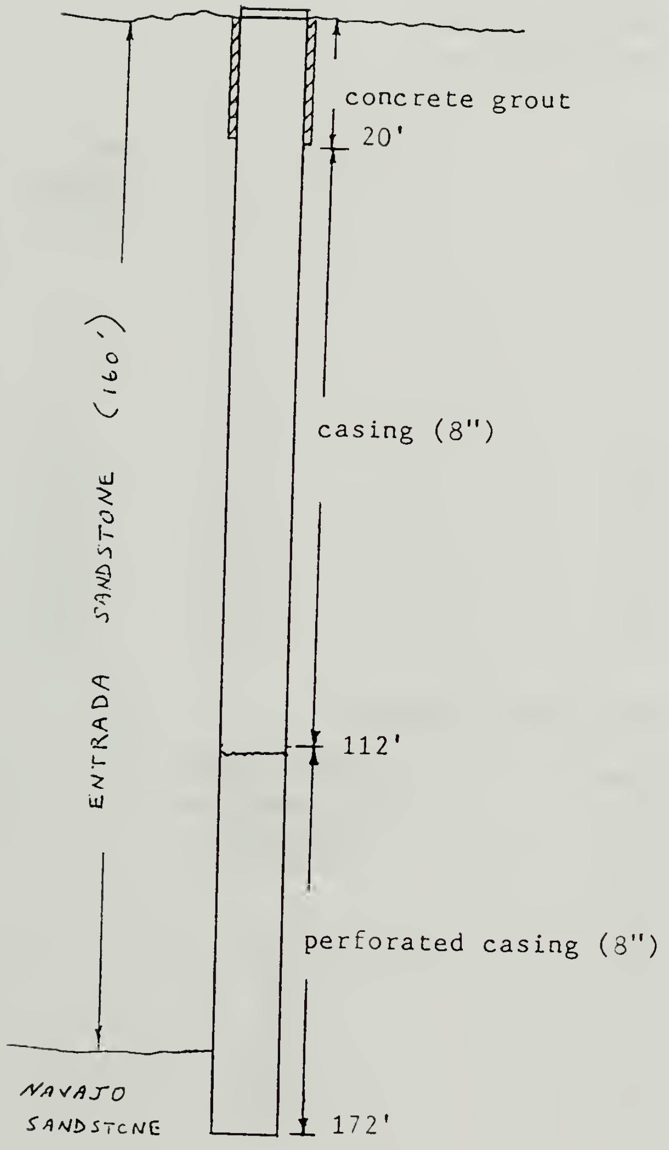
Utah Division of Drinking Water website, http://www.deq.state.ut.us/eqdw/Index.html

Well Log

Drawdown and Yield Testing

New Well

ARCHES NATIONAL PARK



Well drilling date:
Started: 5/17/78
Completed: 5/19/78

Location:
State: Utah
Latitude: 38°36'57"
Longitude: 109°36'40"
Township: 25 S
Range: 21 E
Section: SE¼ NW¼ Sec. 21

Depth:
172'
Casing: 173'(1' above grou
Perforation: 60'
16 cuts/ft.
Perforation Size:
½"X2"
Plug: none

Log Data:
Navajo Sandstone @160'

Driller:
William Peck

Drilling Method:
Cable Tool

Water Level:
114'

WELL SPECIFICATION (as built)

ARCHES NATIONAL PARK

Pumping and Recovery Data from the
New Well drilled May, 1978
Test conducted by Ron Hermance, Water Resources Div., RMR

Pump Test (May 23-24, 1978)

TIME (Minutes)	DEPTH TO WATER (Feet)	DRAWDOWN (Feet)	DISCHARGE (Gal/Min)
0	113.29	-	-
3	113.65	.36	30.2
12	113.66	.37	
22	113.66	.37	
32	113.66	.37	
42	113.66	.37	30.2
72	113.66	.37	
912	115.34	2.05	30.2
972	115.34	2.05	
1032	115.34	2.05	
1122	115.34	2.05	30.2
1212	115.37	2.08	
1332	115.37	2.08	30.2
1452	115.37	2.08	

Recovery Test (May 24-25, 1978)

TIME SINCE PUMP WAS SHUT OFF (Minutes)	DEPTH TO WATER (Feet)	RESIDUAL DRAWDOWN (Feet)
2	115.08	1.79
5	115.04	1.75
10	115.02	1.73
20	115.00	1.71
30	115.00	1.71
110	114.93	1.64
850	114.82	1.53
1240	114.78	1.49

Pump Test Interpretation

The specific capacity was 15 gal/min. per foot of drawdown after pumping for 1452 minutes. The specific capacity data serves only as an indicator of the capability of the aquifer and does not include other necessary data required to make accurate determinations of specific yield. Therefore, the data should be used only for approximating drawdown at pumping rates above 30 gal/min.

Test results indicate that the well should be able to yield 30-50 gal/min. without problems. If the well was pumped at 60 gal/min., the drawdown would probably be around 5-7 feet.

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                     UNITED STATES DEPARTMENT OF THE INTERIOR
                                GEOLOGICAL SURVEY
                       CENTRAL LABORATORY, DENVER, COLORADO

                             WATER QUALITY ANALYSIS
                        LAB ID # 251100 RECORD # 54504

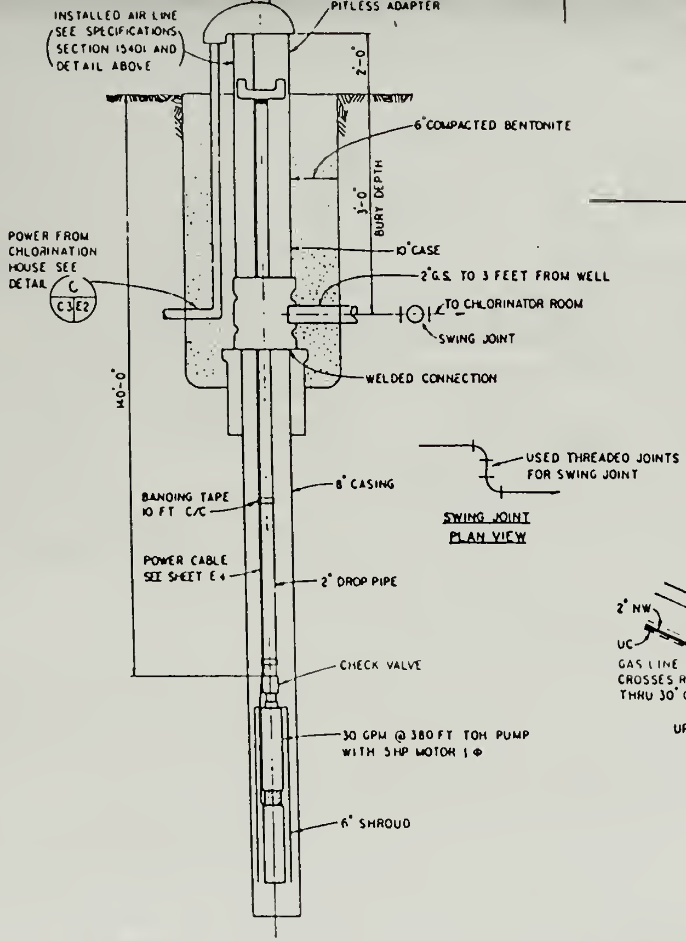
SAMPLE LOCATION: ARCHES N.P. ARCH 1
STATION ID: 383657109364000     LAT.LONG.SEQ.: 383657 1093640 00
DATE OF COLLECTION: BEGIN--780524  END--           TIME--1545
STATE CODE: 49 COUNTY CODE:      PROJECT IDENTIFICATION: 460800300
DATA TYPE: 2  SOURCE: GROUND WATER        GEOLOGIC UNIT:
COMMENTS:
  MAILING ADDRESS: N.P.S., P.O. .BOX 25287


ALK,TOT (AS CACO3)    MG/L       210       PH LAB                             6.2
ANALYZING AGENCY               80020       PHOS ORTHO DIS AS P    DETR. DELETED
BICARBONATE           MG/L       250       PHOSPHORUS DIS AS P  MG/L         0.00
CALCIUM DISS          MG/L        89       POTASSIUM DISS       MG/L         8.7
CHLORIDE DISS         MG/L       160       RESIDUE DIS CALC SUM MG/L       825
FLUORIDE DISS         MG/L         0.4     RESIDUE DIS TON/AFT               1.12
HARDNESS NONCARB      MG/L       150       SAR                               3.2
HARDNESS TOTAL        MG/L       360       SILICA DISSOLVED     MG/L       13
IRON DISSOLVED        UG/L       100       SODIUM DISS          MG/L      140
MAGNESIUM DISS        MG/L        33       SODIUM PERCENT                  45
MANGANESE DISSOLVED   UG/L        20       SP. CONDUCTANCE LAB           1311
NO2+NO3 AS N DISS     MG/L         6.2     SULFATE DISS         MG/L      230


                CATIONS                                        ANIONS

                 (MG/L)            (MEQ/L)                     (MG/L)          (MEQ/L)
CALCIUM DISS      89                 4.442 BICARBONATE         250               4.098
MAGNESIUM DISS    33                 2.715 CHLORIDE DISS       160               4.514
POTASSIUM DISS     8.7               0.223 FLUORIDE DISS         0.4             0.022
SODIUM DISS      140                 6.090 SULFATE DISS        230               4.789
                                           NO2+NO3 AS N D        6.2             0.443
                               ----------                                   ----------
                        TOTAL     13.468                        TOTAL           13.863

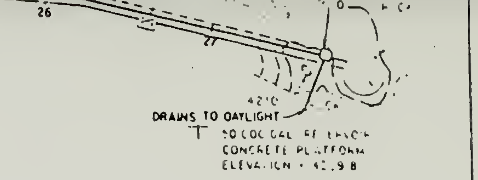
                    PERCENT DIFFERENCE =   -1.45
```

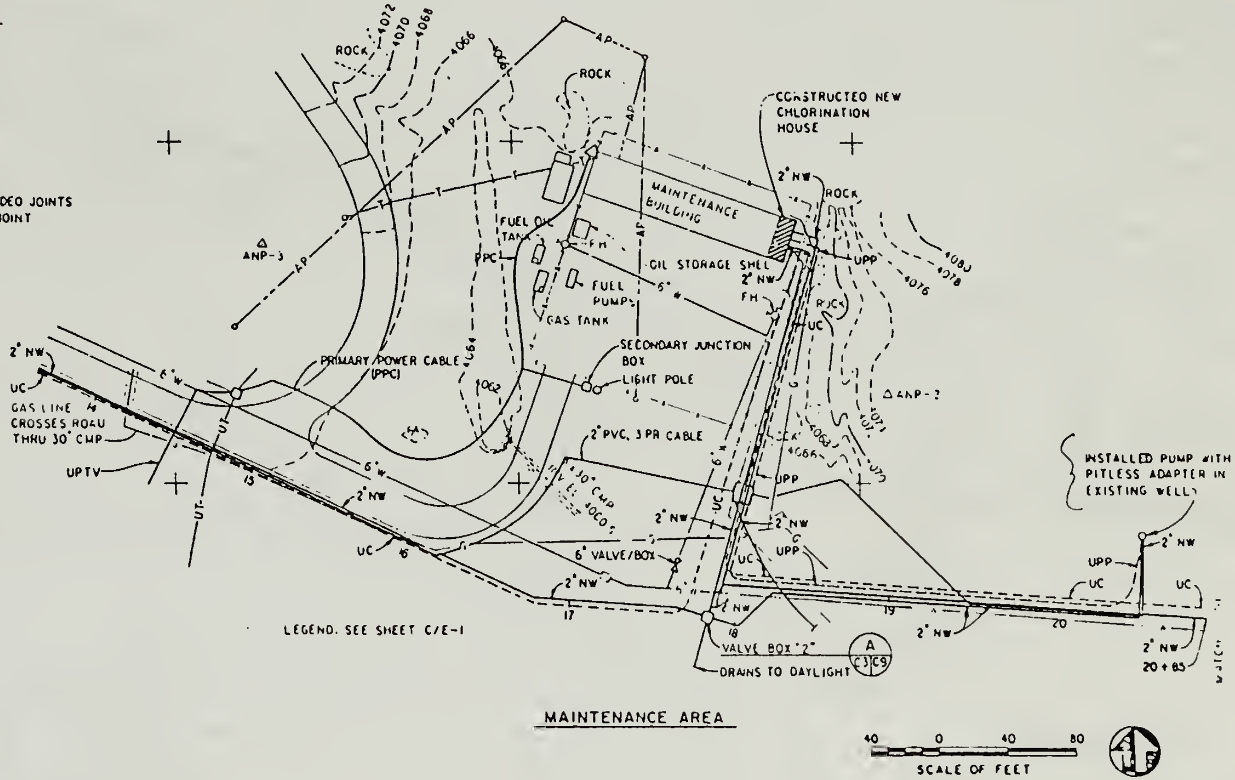


PUMP & PITLESS ADAPTER

INSTALLED PITLESS ADAPTER AND PUMP IN EXISTING WELL

NO SCALE





LEGEND. SEE SHEET C/E-1

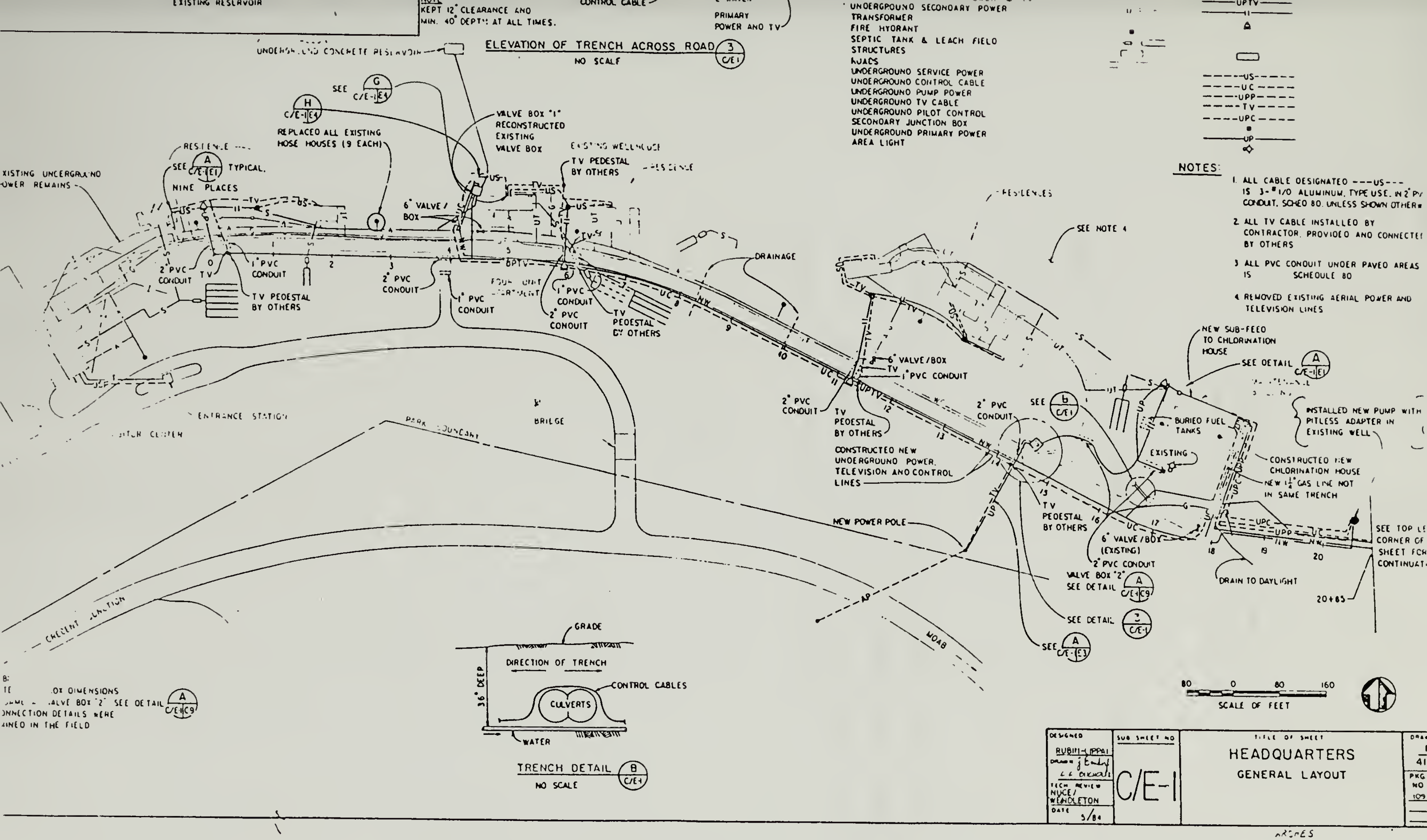
MAINTENANCE AREA

DESIGNED
LIPPAI
DRAWN Bendorf
Seeley
TECH REVIEW
WENDLETON
DATE 5/84

SUB SHEET NO
C3.

TITLE OF SHEET
HEADQUARTERS
PUMP AND PITLESS ADAPTER

DRAWING NO
138
41,006C
PKG NO 109
SHEET 5 OF 19



UNDERGROUND SECONDARY POWER
TRANSFORMER
FIRE HYDRANT
SEPTIC TANK & LEACH FIELD
STRUCTURES
ROADS
UNDERGROUND SERVICE POWER
UNDERGROUND CONTROL CABLE
UNDERGROUND PUMP POWER
UNDERGROUND TV CABLE
UNDERGROUND PILOT CONTROL
SECONDARY JUNCTION BOX
UNDERGROUND PRIMARY POWER
AREA LIGHT

NOTES:

1. ALL CABLE DESIGNATED ---US--- IS 3-#1/0 ALUMINUM, TYPE USE, IN 2" PV CONDUIT, SCHED 80, UNLESS SHOWN OTHERW
2. ALL TV CABLE INSTALLED BY CONTRACTOR, PROVIDED AND CONNECTE BY OTHERS
3. ALL PVC CONDUIT UNDER PAVED AREAS IS SCHEDULE 80
4. REMOVED EXISTING AERIAL POWER AND TELEVISION LINES

DESIGNED	SUB SHEET NO	TITLE OF SHEET
RUBIN-LIPPAI DRAWN J. Embry L. L. Michaels TECH REVIEW NUCE/WENDLETON DATE 5/84	C/E-1	HEADQUARTERS GENERAL LAYOUT

ARCHES

ARCHES HEADQUARTERS WELLS

General Information - 3/29/78

1940 - Original well was drilled in the present Headquarters area.

Depth 117'

Casing 6"

Flow - Est. 30 to 40 g.p.m.

1958 - A replacement well was drilled 20' (and 5' higher) from existing well. According to Don Price, USGS, in his Memorandum Summarizing the Drilling and Test Pumping Etc., "The new well was needed in order to meet the growing water requirements at the Monument."

Depth 123.4'

Casing 8"

Test Pumped 12 g.p.m.

Present pumping ± 20 g.p.m.

JCU/tb

Water Quality Data

Division of Water Quality

1996 Lab Analysis Report

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9600390
Sample Source: 02
Sample Date: January 18, 1996
Sample Time: 1009
Sample Type: 04

Field Tests

Field Temperature, C	9.7	pH, units	7.3
D.O., mg/l	5.6	Sp. Cond., umhos/cm	1274

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	D-Arsenic, ug/l	<5.0
D-Barium, ug/l	25.0	D-Cadmium, ug/l	<1.0
D-Calcium, mg/l	84	D-Chromium, ug/l	<5.0
D-Copper, ug/l	<12.0	Iron, Diss., ug/l	<20.0
D-Lead, ug/l	<3.0	D-Magnesium, mg/l	35
D-Manganese, ug/l	<5.0	D-Nickel, ug/l	<10.0
D-Potassium, mg/l	8	D-Selenium, ug/l	6.0
D-Silver, ug/l	<2.0	D-Sodium, mg/l	120.0
D-Zinc, ug/l	87.0	Bicarbonate, mg/l	246
Carbon Dioxide, mg/l	6	Carbonate, mg/l	0
Chloride, mg/l	64.0	Fluoride, mg/l	0.424
Hydroxide, mg/l	0	Sulfate, mg/l	232.3
T. Alk/CaCO3, mg/l	202	T. Hdns/CaCO3, mg/l	353.6
Turbidity, NTU	0.47	Sp. Cond. umhos/cm.	1305
TDS @ 180 C, mg/l	816	H+Uranium, ug/l	8.4
Alpha, gross, pc/l	6	Beta, gross, pc/l	17
226 Radium, pc/l	<0.5	228 Radium, pc/l	<1
D-Aluminum, ug/l	<30.0	D-Beryllium, ug/l	<1.0
D-Molybdenum, ug/l	<2.0	D-Vanadium, ug/l	<40.0
D-Thallium, ug/l	<1.0	D-Antimony, ug/l	<3.0
D-Mercury, ug/l	<0.2	CO3 Solids	121

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9601432
Sample Source: 02
Sample Date: February 28, 1996
Sample Time: 1136
Sample Type: 04

Field Tests

Field Temperature, C	10.0	pH, units	7.9
D.O., mg/l	6.0		

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	NO2+NO3, N, mg/l	6.46
T.K.N., mg/l	0.27	Ammonia as N, mg/l	<0.05
D-Arsenic, ug/l	<5.0	D-Barium, ug/l	26.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	86
D-Chromium, ug/l	<5.0	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	92.0	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	35	D-Manganese, ug/l	<5.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	8
D-Selenium, ug/l	4.0	D-Silver, ug/l	<2.0
D-Sodium, mg/l	120.0	D-Zinc, ug/l	160.0
Bicarbonate, mg/l	248	Carbon Dioxide, mg/l	3
Carbonate, mg/l	0	Chloride, mg/l	141.0
Fluoride, mg/l	0.421	Hydroxide, mg/l	0
Sulfate, mg/l	225.0	T. Phosphorus, mg/l	<0.01
T. Alk/CaCO3, mg/l	203	T. Hdns/CaCO3, mg/l	358.6
Turbidity, NTU	0.85	Sp. Cond. umhos/cm.	1276
TDS @ 180 C, mg/l	794	H+Uranium, ug/l	9.2
Alpha, gross, pc/l	9.2	Beta, gross, pc/l	<10
226 Radium, pc/l	<0.5	228 Radium, pc/l	<1
D-Aluminum, ug/l	<30.0	D-Beryllium, ug/l	<0
D-Molybdenum, ug/l	2.0	D-Vanadium, ug/l	<40.0
D-Thallium, ug/l	<1.0	D-Antimony, ug/l	<3.0
D-Mercury, ug/l	<0.2	CO3 Solids	122

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9606388
Sample Source: 02
Sample Date: July 24, 1996
Sample Time: 1600
Sample Type: 04

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	NO2+NO3, N, mg/l	3.43
T.K.N., mg/l	0.152	Ammonia as N, mg/l	<0.05
D-Arsenic, ug/l	<5.0	D-Barium, ug/l	33.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	94.6
D-Chromium, ug/l	<5.0	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	28.7	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	38.1	D-Manganese, ug/l	<5.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	9.6
D-Selenium, ug/l	9.3	D-Silver, ug/l	<2.0
D-Sodium, mg/l	191.0	Bicarbonate, mg/l	226
Carbon Dioxide, mg/l	7	Carbonate, mg/l	0
Chloride, mg/l	260.0	Hydroxide, mg/l	0
Sulfate, mg/l	273.7	T. Phosphorus, mg/l	<0.01
T. Alk/CaCO3, mg/l	185	T. Hdns/CaCO3, mg/l	392.8
Turbidity, NTU	0.303	Sp. Cond. umhos/cm.	1614
TDS @ 180 C, mg/l	966	Alpha, gross, pc/l	24
Beta, gross, pc/l	13.9	226 Radium, pc/l	<0.5
228 Radium, pc/l	1	T-Uranium, ug/l	9.1
CO3 Solids	111		

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9611520
Sample Source: 02
Sample Date: December 18, 1996
Sample Time: 1546
Sample Type: 04

Field Tests

Field Temperature, C	13.3	pH, units	7.6
D.O., mg/l	6.0	Sp. Cond., umhos/cm	1258

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	NO2+NO3, N, mg/l	5.3
T.K.N., mg/l	0.17	Ammonia as N, mg/l	<0.05
D-Arsenic, ug/l	<5.0	D-Barium, ug/l	37.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	89.8
D-Chromium, ug/l	<5.0	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	<20.0	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	36.9	D-Manganese, ug/l	<5.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	8.42
D-Selenium, ug/l	18.0	D-Silver, ug/l	<2.0
D-Sodium, mg/l	135.0	D-Zinc, ug/l	52.0
Bicarbonate, mg/l	240	Carbon Dioxide, mg/l	4
Carbonate, mg/l	0	Chloride, mg/l	160.0
Fluoride, mg/l	0.45	Hydroxide, mg/l	0
Sulfate, mg/l	235.8	T. Phosphorus, mg/l	<0.01
T. Alk/CaCO3, mg/l	197	T. Hdns/CaCO3, mg/l	375.9
Turbidity, NTU	0.249	Sp. Cond. umhos/cm.	1347
TDS @ 180 C, mg/l	820	Alpha, gross, pc/l	16
Beta, gross, pc/l	14	226 Radium, pc/l	<0.5
228 Radium, pc/l	2.5	D-Aluminum, ug/l	<30.0
D-Beryllium, ug/l	<1.0	D-Molybdenum, ug/l	2.3
D-Vanadium, ug/l	<30.0	T-Uranium, ug/l	<1.0
D-Thallium, ug/l	<1.0	D-Antimony, ug/l	<3.0
D-Mercury, ug/l	<0.2	CO3 Solids	113

Division of Water Quality

1997 Lab Analysis Report

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9700191
Sample Source: 02
Sample Date: January 07, 1997
Sample Time: 1340
Sample Type: 04

Field Tests

Field Temperature, C	16.6	pH, units	7.3
D.O., mg/l	5.7	Sp. Cond., umhos/cm	1220
Flow, GPM	33.0		

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	NO2+NO3, N, mg/l	6.34
T.K.N., mg/l	0.0405	Ammonia as N, mg/l	<0.05
D-Arsenic, ug/l	<5.0	D-Barium, ug/l	26.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	88
D-Chromium, ug/l	<5.0	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	<20.0	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	36.6	D-Manganese, ug/l	<5.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	7.98
D-Selenium, ug/l	8.8	D-Silver, ug/l	<2.0
D-Sodium, mg/l	114.0	D-Zinc, ug/l	89.0
Bicarbonate, mg/l	242	Carbon Dioxide, mg/l	5
Carbonate, mg/l	0	Chloride, mg/l	132.5
Fluoride, mg/l	0.405	Hydroxide, mg/l	0
Sulfate, mg/l	211.0	T. Phosphorus, mg/l	0.02329
T. Alk/CaCO3, mg/l	198	T. Hdns/CaCO3, mg/l	370.2
Turbidity, NTU	0.367	Sp. Cond. umhos/cm.	1192
TDS @ 180 C, mg/l	770	D-Aluminum, ug/l	<30.0
D-Beryllium, ug/l	<1.0	D-Molybdenum, ug/l	2.4
D-Uranium, ug/l	3.4	D-Vanadium, ug/l	<30.0
D-Thallium, ug/l	<1.0	D-Antimony, ug/l	<3.0
D-Mercury, ug/l	<0.2	CO3 Solids	119
Dissolved Gross Alph	7	Dissolved Gross Beta	13.3
Dissolved RA-226	0.7	Dissolved RA-228	<1

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9700543
Sample Source: 02
Sample Date: January 22, 1997
Sample Time: 1200
Sample Type: 04

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	NO2+NO3, N, mg/l	6.68
T.K.N., mg/l	0.099	Ammonia as N, mg/l	<0.05
D-Arsenic, ug/l	<5.0	D-Barium, ug/l	24.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	88.2
D-Chromium, ug/l	7.6	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	<20.0	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	38.2	D-Manganese, ug/l	<5.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	8.41
D-Selenium, ug/l	9.4	D-Silver, ug/l	<2.0
D-Sodium, mg/l	127.0	D-Zinc, ug/l	37.0
Bicarbonate, mg/l	242	Carbon Dioxide, mg/l	5
Carbonate, mg/l	0	Chloride, mg/l	147.5
Fluoride, mg/l	0.377	Hydroxide, mg/l	0
Sulfate, mg/l	207.3	T. Alk/CaCO3, mg/l	198
T. Hdns/CaCO3, mg/l	377.2	Turbidity, NTU	0.327
Sp. Cond. umhos/cm.	1253	TDS @ 180 C, mg/l	802
D-Aluminum, ug/l	<30.0	D-Beryllium, ug/l	<1.0
D-Molybdenum, ug/l	2.4	D-Uranium, ug/l	2.3
D-Vanadium, ug/l	<30.0	D-Thallium, ug/l	<1.0
D-Antimony, ug/l	<3.0	D-Mercury, ug/l	<0.2
CO3 Solids	119	Dissolved Gross Alph	14.6
Dissolved Gross Beta	13.3	Dissolved RA-226	<0.05
Dissolved RA-228	<1		

Division of Water Quality

1997 Lab Analysis Report

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9701171
Sample Source: 02
Sample Date: February 13, 1997
Sample Time: 1031
Sample Type: 04

Field Tests

Field Temperature, C	12.2	pH, units	7.7
D.O., mg/l	6.1	Sp. Cond., umhos/cm	1309

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	NO2+NO3, N, mg/l	5.47
T.K.N., mg/l	0.215	Ammonia as N, mg/l	<0.05
D-Arsenic, ug/l	<5.0	D-Barium, ug/l	<5.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	87.4
D-Chromium, ug/l	<5.0	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	<20.0	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	35.3	D-Manganese, ug/l	<5.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	8.16
D-Selenium, ug/l	<1.0	D-Silver, ug/l	<2.0
D-Sodium, mg/l	135.0	D-Zinc, ug/l	<30.0
Bicarbonate, mg/l	246	Carbon Dioxide, mg/l	6
Carbonate, mg/l	0	Chloride, mg/l	170.0
Fluoride, mg/l	2.25	Hydroxide, mg/l	0
Sulfate, mg/l	201.7	T. Alk/CaCO3, mg/l	202
T. Hdns/CaCO3, mg/l	363.3	Turbidity, NTU	0.138
Sp. Cond. umhos/cm.	1346	TDS @ 180 C, mg/l	852
D-Aluminum, ug/l	<30.0	D-Beryllium, ug/l	<1.0
D-Molybdenum, ug/l	2.4	D-Uranium, ug/l	7.0
D-Vanadium, ug/l	<30.0	D-Thallium, ug/l	<1.0
D-Antimony, ug/l	<3.0	D-Mercury, ug/l	<0.2
CO3 Solids	121	Dissolved Gross Alph	11.6
Dissolved Gross Beta	14.2	Dissolved RA-226	0.5
Dissolved RA-228	1.8		

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9702534
Sample Source: 02
Sample Date: April 03, 1997
Sample Time: 0919
Sample Type: 04

Field Tests

Field Temperature, C	13.77	pH, units	7.23
D.O., mg/l	5.26	Sp. Cond., umhos/cm	1088

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	NO2+NO3, N, mg/l	5.29
T.K.N., mg/l	<0.5	Ammonia as N, mg/l	<0.05
D-Arsenic, ug/l	<5.0	D-Barium, ug/l	26.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	87.7
D-Chromium, ug/l	<5.0	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	<20.0	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	35.8	D-Manganese, ug/l	<5.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	8.12
D-Selenium, ug/l	8.9	D-Silver, ug/l	<2.0
D-Sodium, mg/l	135.0	D-Zinc, ug/l	110.0
Bicarbonate, mg/l	238	Carbon Dioxide, mg/l	6
Carbonate, mg/l	0	Chloride, mg/l	162.5
Fluoride, mg/l	0.513	Hydroxide, mg/l	0
Sulfate, mg/l	205.5	T. Phosphorus, mg/l	0.02042
T. Alk/CaCO3, mg/l	195	T. Hdns/CaCO3, mg/l	366.1
Turbidity, NTU	0.261	Sp. Cond. umhos/cm.	1342
TDS @ 180 C, mg/l	838	D-Aluminum, ug/l	<30.0
D-Beryllium, ug/l	<1.0	D-Molybdenum, ug/l	2.6
D-Uranium, ug/l	13.2	D-Vanadium, ug/l	<30.0
D-Thallium, ug/l	<1.0	D-Antimony, ug/l	<3.0
D-Mercury, ug/l	<0.2	CO3 Solids	117
Dissolved Gross Alph	6.4	Dissolved Gross Beta	12
Dissolved RA-226	<0.5	Dissolved RA-228	<1

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9704174
Sample Source: 02
Sample Date: May 16, 1997
Sample Time: 1017
Sample Type: 04

Field Tests

Field Temperature, C	19.6	pH, units	7.56
D.O., mg/l	4.56	Sp. Cond., umhos/cm	569

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	NO2+NO3, N, mg/l	1.0
T.K.N., mg/l	<0.5	Ammonia as N, mg/l	<0.05
D-Arsenic, ug/l	<5.0	D-Barium, ug/l	24.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	85.7
D-Chromium, ug/l	6.8	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	<20.0	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	35.8	D-Manganese, ug/l	<5.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	8.31
D-Selenium, ug/l	8.6	D-Silver, ug/l	<2.0
D-Sodium, mg/l	147.0	D-Zinc, ug/l	<30.0
Bicarbonate, mg/l	226	Carbon Dioxide, mg/l	4
Carbonate, mg/l	0	Chloride, mg/l	176.5
Fluoride, mg/l	0.421	Hydroxide, mg/l	0
Sulfate, mg/l	202.74	T. Alk/CaCO3, mg/l	185
T. Hdns/CaCO3, mg/l	361.1	Turbidity, NTU	0.136
Sp. Cond. umhos/cm.	1380	TDS @ 180 C, mg/l	866
D-Aluminum, ug/l	<30.0	D-Beryllium, ug/l	<1.0
D-Molybdenum, ug/l	2.4	D-Uranium, ug/l	5.6
D-Vanadium, ug/l	<30.0	D-Thallium, ug/l	<1.0
D-Antimony, ug/l	<3.0	D-Mercury, ug/l	<0.2
CO3 Solids	111	Dissolved Gross Alph	10.322
Dissolved Gross Beta	<10	Dissolved RA-226	<0.5
Dissolved RA-228	2.28		

Division of Water Quality

/15/2000 17:57 22.03 ADH Page: 1

1998 Lab Analysis Report

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9800285
Sample Source: 02
Sample Date: January 14, 1998
Sample Time: 1520
Sample Type: 04

Field Tests

Field Temperature, C	17.0	pH, units	7.8
D.O., mg/l	5.6	Sp. Cond., umhos/cm	1389

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	Ammonia as N, mg/l	<0.05
D-Arsenic, ug/l	<5.0	D-Barium, ug/l	25.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	93.7
D-Chromium, ug/l	<5.0	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	<20.0	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	36.7	D-Manganese, ug/l	<5.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	8.63
D-Selenium, ug/l	8.5	D-Silver, ug/l	<2.0
D-Sodium, mg/l	141.0	D-Zinc, ug/l	47.0
Bicarbonate, mg/l	236	Carbon Dioxide, mg/l	5
Carbonate, mg/l	0	Chloride, mg/l	165.0
Fluoride, mg/l	0.42	Hydroxide, mg/l	0
Sulfate, mg/l	260.0	T. Alk/CaCO3, mg/l	194
T. Hdns/CaCO3, mg/l	384.8	Turbidity, NTU	0.088
Sp. Cond. umhos/cm.	1290	TDS @ 180 C, mg/l	814
D-Aluminum, ug/l	<30.0	D-Beryllium, ug/l	<1.0
D-Molybdenum, ug/l	3.6	D-Uranium, ug/l	12.2
D-Vanadium, ug/l	<30.0	D-Thallium, ug/l	<1.0
D-Antimony, ug/l	<3.0	NO2+NO3 Diss	4.61
D-Mercury, ug/l	<0.2	CO3 Solids	116
Dis. Tot. Phos. mg/l	<0.01	Dissolved Gross Alph	14
Dissolved Gross Beta	<10	Dissolved RA-226	<0.5
Dissolved RA-228	<1		

Division of Water Quality

1998 Lab Analysis Report

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9801212
Sample Source: 02
Sample Date: February 18, 1998
Sample Time: 1403
Sample Type: 04

Field Tests

Field Temperature, C	17.9	pH, units	6.7
D.O., mg/l	3.9	Sp. Cond., umhos/cm	1205

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	Ammonia as N, mg/l	<0.05
D-Arsenic, ug/l	<5.0	D-Barium, ug/l	27.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	90.2
D-Chromium, ug/l	<5.0	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	<20.0	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	36.1	D-Manganese, ug/l	<5.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	8.53
D-Selenium, ug/l	8.6	D-Silver, ug/l	<2.0
D-Sodium, mg/l	133.0	D-Zinc, ug/l	38.0
Bicarbonate, mg/l	242	Carbon Dioxide, mg/l	6
Carbonate, mg/l	0	Chloride, mg/l	144.0
Fluoride, mg/l	0.429	Hydroxide, mg/l	0
Sulfate, mg/l	197.55	T. Phosphorus, mg/l	<0.015
T. Alk/CaCO3, mg/l	198	T. Hdns/CaCO3, mg/l	373.6
Turbidity, NTU	0.298	Sp. Cond. umhos/cm.	1280
TDS @ 180 C, mg/l	812	D-Aluminum, ug/l	<30.0
D-Beryllium, ug/l	<1.0	D-Molybdenum, ug/l	2.7
D-Uranium, ug/l	10.0	D-Vanadium, ug/l	<30.0
D-Thallium, ug/l	<1.0	D-Antimony, ug/l	<3.0
NO2+NO3 Diss	5.89	D-Mercury, ug/l	<0.2
CO3 Solids	119	Dis. Tot. Phos. mg/l	<0.01
Dissolved Gross Alph	24.9	Dissolved Gross Beta	<10
Dissolved RA-226	1.08	Dissolved RA-228	1.01

Division of Water Quality

1998 Lab Analysis Report

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9803216
Sample Source: 02
Sample Date: May 06, 1998
Sample Time: 1632
Sample Type: 04

Field Tests

Field Temperature, C	18.5	pH, units	7.47
D.O., mg/l	3.7	Sp. Cond., umhos/cm	1299
Flow, MGD	0.71		

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	Ammonia as N, mg/l	0.52
D-Arsenic, ug/l	<5.0	D-Barium, ug/l	25.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	90.8
D-Chromium, ug/l	<5.0	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	<20.0	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	35.5	D-Manganese, ug/l	<5.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	8.31
D-Selenium, ug/l	13.0	D-Silver, ug/l	<2.0
D-Sodium, mg/l	135.0	D-Zinc, ug/l	47.0
Bicarbonate, mg/l	234	Carbon Dioxide, mg/l	6
Carbonate, mg/l	0	Chloride, mg/l	154.7
Fluoride, mg/l	0.42	Hydroxide, mg/l	0
Sulfate, mg/l	248.0	T. Phosphorus, mg/l	<0.02
T. Alk/CaCO3, mg/l	192	T. Hdns/CaCO3, mg/l	372.6
Turbidity, NTU	0.1	Sp. Cond. umhos/cm.	1310
TDS @ 180 C, mg/l	846	D-Aluminum, ug/l	<30.0
D-Beryllium, ug/l	<1.0	D-Molybdenum, ug/l	2.3
D-Uranium, ug/l	5.4	D-Vanadium, ug/l	<30.0
D-Thallium, ug/l	<1.0	D-Antimony, ug/l	<3.0
NO2+NO3 Diss	5.77	D-Mercury, ug/l	<0.2
CO3 Solids	115	Dis. Tot. Phos. mg/l	<0.02
Dissolved Gross Alph	17.4	Dissolved Gross Beta	12.4
Dissolved RA-226	0.956	Dissolved RA-228	<1

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9804218
Sample Source: 02
Sample Date: June 03, 1998
Sample Time: 1510
Sample Type: 04

Field Tests

Field Temperature, C	20.9	pH, units	8.2
D.O., mg/l	4.0	Sp. Cond., umhos/cm	1363

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	Ammonia as N, mg/l	<0.05
D-Arsenic, ug/l	<5.0	D-Barium, ug/l	28.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	93.4
D-Chromium, ug/l	<5.0	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	<20.0	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	37.1	D-Manganese, ug/l	<5.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	9.07
D-Selenium, ug/l	8.3	D-Silver, ug/l	<2.0
D-Sodium, mg/l	146.0	D-Zinc, ug/l	43.0
Bicarbonate, mg/l	236	Carbon Dioxide, mg/l	6
Carbonate, mg/l	0	Chloride, mg/l	175.0
Fluoride, mg/l	0.42	Hydroxide, mg/l	0
Sulfate, mg/l	229.0	T. Phosphorus, mg/l	<0.02
T. Alk/CaCO3, mg/l	194	T. Hdns/CaCO3, mg/l	385.7
Turbidity, NTU	0.153	Sp. Cond. umhos/cm.	1350
TDS @ 180 C, mg/l	878	D-Aluminum, ug/l	<30.0
D-Beryllium, ug/l	<1.0	D-Molybdenum, ug/l	2.4
D-Uranium, ug/l	9.44	D-Vanadium, ug/l	<30.0
D-Thallium, ug/l	<1.0	D-Antimony, ug/l	<3.0
NO2+NO3 Diss	5.17	D-Mercury, ug/l	<0.2
CO3 Solids	116	Dis. Tot. Phos. mg/l	<0.02
Dissolved Gross Alph	7.12	Dissolved Gross Beta	18.3
Dissolved RA-226	8.51	Dissolved RA-228	<1

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9804904
Sample Source: 02
Sample Date: June 25, 1998
Sample Time: 0816
Sample Type: 04

Field Tests

Field Temperature, C	20.91	pH, units	7.39
D.O., mg/l	4.45	Sp. Cond., umhos/cm	1517

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	Ammonia as N, mg/l	<0.05
D-Arsenic, ug/l	<5.0	D-Barium, ug/l	29.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	96.6
D-Chromium, ug/l	9.6	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	<20.0	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	37.3	D-Manganese, ug/l	<5.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	9.26
D-Selenium, ug/l	9.0	D-Silver, ug/l	<2.0
D-Sodium, mg/l	165.0	D-Zinc, ug/l	35.0
Bicarbonate, mg/l	0	Carbon Dioxide, mg/l	-101
Carbonate, mg/l	0	Chloride, mg/l	210.0
Fluoride, mg/l	0.46	Hydroxide, mg/l	210.0
Sulfate, mg/l	243.08	T. Phosphorus, mg/l	<0.02
T. Alk/CaCO3, mg/l	195	T. Hdns/CaCO3, mg/l	394.5
Turbidity, NTU	0.073	Sp. Cond. umhos/cm.	1440
TDS @ 180 C, mg/l	944	D-Aluminum, ug/l	<30.0
D-Beryllium, ug/l	<1.0	D-Molybdenum, ug/l	2.3
D-Uranium, ug/l	9.41	D-Vanadium, ug/l	<30.0
D-Thallium, ug/l	<1.0	D-Antimony, ug/l	<3.0
NO2+NO3 Diss	4.51	D-Mercury, ug/l	<0.2
CO3 Solids	117	Dis. Tot. Phos. mg/l	<0.02
Dissolved Gross Alph	8.94	Dissolved Gross Beta	15.2
Dissolved RA-226	<0.5	Dissolved RA-228	<1

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9806427
Sample Source: 02
Sample Date: July 30, 1998
Sample Time: 0846
Sample Type: 04

Field Tests

Field Temperature, C	23.48	pH, units	7.58
D.O., mg/l	5.09	Sp. Cond., umhos/cm	1518

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	Ammonia as N, mg/l	<0.05
D-Arsenic, ug/l	<5.0	D-Barium, ug/l	35.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	90.8
D-Chromium, ug/l	<5.0	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	<20.0	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	39	D-Manganese, ug/l	<5.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	9.85
D-Selenium, ug/l	7.6	D-Silver, ug/l	<2.0
D-Sodium, mg/l	175.0	D-Zinc, ug/l	78.0
Bicarbonate, mg/l	234	Carbon Dioxide, mg/l	6
Carbonate, mg/l	0	Chloride, mg/l	230.0
Fluoride, mg/l	0.397	Hydroxide, mg/l	0
Sulfate, mg/l	256.69	T. Phosphorus, mg/l	<0.02
T. Alk/CaCO3, mg/l	192	T. Hdns/CaCO3, mg/l	387.0
Turbidity, NTU	1.24	Sp. Cond. umhos/cm.	1560
TDS @ 180 C, mg/l	944	D-Aluminum, ug/l	<30.0
D-Beryllium, ug/l	<1.0	D-Molybdenum, ug/l	2.4
D-Uranium, ug/l	4.8	D-Vanadium, ug/l	<30.0
D-Thallium, ug/l	<1.0	D-Antimony, ug/l	<3.0
NO2+NO3 Diss	3.88	D-Mercury, ug/l	<0.2
CO3 Solids	115	Dis. Tot. Phos. mg/l	<0.02
Dissolved Gross Alph	10.1	Dissolved Gross Beta	17.3
Dissolved RA-226	<0.5	Dissolved RA-228	5.32

Division of Water Quality

1998 Lab Analysis Report

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9808209
Sample Source: 02
Sample Date: September 16, 1998
Sample Time: 0723
Sample Type: 04

Field Tests

Field Temperature, C	18.5	pH, units	7.7
D.O., mg/l	7.1	Sp. Cond., umhos/cm	1273

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	Ammonia as N, mg/l	<0.05
D-Arsenic, ug/l	<55.0	D-Barium, ug/l	25.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	93.2
D-Chromium, ug/l	<5.0	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	<20.0	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	36.3	D-Manganese, ug/l	<5.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	9.16
D-Selenium, ug/l	8.8	D-Silver, ug/l	<2.0
D-Sodium, mg/l	141.0	D-Zinc, ug/l	<30.0
Bicarbonate, mg/l	232	Carbon Dioxide, mg/l	6
Carbonate, mg/l	0	Chloride, mg/l	177.5
Fluoride, mg/l	0.419	Hydroxide, mg/l	0
Sulfate, mg/l	235.9	T. Phosphorus, mg/l	<0.02
T. Alk/CaCO3, mg/l	190	T. Hdns/CaCO3, mg/l	381.9
Turbidity, NTU	0.068	Sp. Cond. umhos/cm.	1329
TDS @ 180 C, mg/l	866	D-Aluminum, ug/l	<30.0
D-Beryllium, ug/l	<1.0	D-Molybdenum, ug/l	2.4
D-Uranium, ug/l	5.3	D-Vanadium, ug/l	<30.0
D-Thallium, ug/l	<1.0	D-Antimony, ug/l	<3.0
NO2+NO3 Diss	5.67	D-Mercury, ug/l	<0.2
CO3 Solids	114	Dis. Tot. Phos. mg/l	<0.02
Dissolved Gross Alph	18.3	Dissolved Gross Beta	29.1
Dissolved RA-226	<0.05	Dissolved RA-228	0.09

Storet No: 495658
Description: ARCHES NATIONAL PARK HDQT WELL
Lab Code: C
Lab Number: 9809920
Sample Source: 02
Sample Date: October 29, 1998
Sample Time: 0735
Sample Type: 04

Field Tests

Field Temperature, C	19.8	pH, units	7.6
D.O., mg/l	4.9	Sp. Cond., umhos/cm	1318

Laboratory Analyses

T. Sus. Solids, mg/l	<4.0	Ammonia as N, mg/l	<0.05
D-Arsenic, ug/l	<5.0	D-Barium, ug/l	26.0
D-Cadmium, ug/l	<1.0	D-Calcium, mg/l	90.1
D-Chromium, ug/l	5.0	D-Copper, ug/l	<12.0
Iron, Diss., ug/l	527.0	D-Lead, ug/l	<3.0
D-Magnesium, mg/l	36.9	D-Manganese, ug/l	16.0
D-Nickel, ug/l	<10.0	D-Potassium, mg/l	8.91
D-Selenium, ug/l	8.1	D-Silver, ug/l	<2.0
D-Sodium, mg/l	152.0	D-Zinc, ug/l	220.0
Bicarbonate, mg/l	230	Carbon Dioxide, mg/l	8
Carbonate, mg/l	0	Chloride, mg/l	182.5
Fluoride, mg/l	0.5	Hydroxide, mg/l	0
Sulfate, mg/l	228.1	T. Phosphorus, mg/l	<0.02
T. Alk/CaCO3, mg/l	189	T. Hdns/CaCO3, mg/l	376.6
Turbidity, NTU	2.55	Sp. Cond. umhos/cm.	1300
TDS @ 180 C, mg/l	862	D-Aluminum, ug/l	<30.0
D-Beryllium, ug/l	<1.0	D-Molybdenum, ug/l	2.1
D-Uranium, ug/l	6.1	D-Vanadium, ug/l	<30.0
D-Thallium, ug/l	<1.0	D-Antimony, ug/l	<3.0
NO2+NO3 Diss	4.32	D-Mercury, ug/l	<0.2
CO3 Solids	113	Dis. Tot. Phos. mg/l	<0.02
Dissolved Gross Alph	16.5	Dissolved Gross Beta	11.1
Dissolved RA-226	<0.5	Dissolved RA-228	1.1